AN OBJECTIVE DECISION TOOL FOR USE IN CONSIDERING AIR FORCE SPECIALTY CODE PAIRS FOR CONSOLIDATION

GRADUATE RESEARCH PROJECT

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Abstract

Throughout its history, the Air Force has experienced a growth in the diversity of the jobs it has been asked to perform, as well as a reduction in the number of personnel it has as a resource to fulfill these requirements. As a result, Air Force leadership has periodically had to review the set of required skills and consolidate similar specialties in order to complete its mission under these more restrictive manpower numbers. However, during previous consolidation efforts, Air Force Specialty Code pairs were identified anecdotally and subject matter experts were brought in to evaluate the feasibility of merging only these career fields.

In response to higher deployment tempos and a recent manpower drawdown, the Air Force Deputy Chief of Staff for Manpower and Personnel received a tasking to develop an objective, repeatable process for identifying AFSC pairs that may be consolidated to ease the operations tempo on Airmen within the force. This research is in response to that tasking and addresses the issues associated with merging specialty codes, ultimately formulating an objective cost/benefit ratio to identify skill pairings which will be likely to merge successfully.

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To my family for all your support during this research and my entire career. I could not have done this without you.

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Kenneth A. Marentette

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AN OBJECTIVE DECISION TOOL FOR USE IN CONSIDERING AIR FORCE SPECIALTY CODE PAIRS FOR CONSOLIDATION

I. Introduction

Background

Throughout its history, the Air Force has experienced a growth in the diversity of the jobs it has been asked to perform, as well as a reduction in the number of personnel it has as a resource to fulfill these requirements. As a result, Air Force leadership has periodically had to review the set of required skills and consolidate similar specialties in order to complete its mission under these more restrictive manpower numbers.

However, during previous consolidation efforts, Air Force Specialty Code (AFSC) pairs were identified anecdotally and subject matter experts (SMEs) were brought in to evaluate the feasibility of merging only these career fields. Not only did this expend precious time for these SMEs in evaluating pairings that could have been previously eliminated through basic computational measures, but it allowed for the omission of potentially successful skill pairs if they were not considered in the initial stages of the process. A basic mathematical model will allow for consideration of a much greater number of skill pairs by eliminating candidates with a low potential for successful consolidation and identifying pairs with the highest potential. Additionally, a

mathematical model will reduce the amount of bias that leaches into the decision process by operating as an objective decision tool for senior Air Force leaders.

Motivation

In response to higher deployment tempos and the recent manpower drawdown, the Air Force Deputy Chief of Staff for Manpower and Personnel (AF/A1) received a CORONA tasking to develop an objective, repeatable process for identifying AFSC pairs that may be consolidated to ease the operations tempo on Airmen within the force. AF/A1 subsequently hired a contractor to develop a measure of fit to fulfill this tasking. The contractor was given access to Air Force personnel systems and was authorized to interview SMEs.

Problem Statement

While the contractor has collected myriad data on AFSCs and conducted surveys of SMEs to evaluate the compatibility of likely AFSC pairs, the contractor has yet to create an objective measure of compatibility from the data; instead, the contractor has fallen into the same pitfall as previous consolidation efforts and used anecdotal data to recommend likely AFSC consolidation pairs. AF/A1 has requested: an analysis of the data provided to the contractor, research of interactions that could predict possible costs and benefits of a merger, and proposal of a means of evaluating the data that would result in a compatibility measure void of bias and anecdotal recommendations.

Research Objective

Create a scaled, objective measure of fit to aid Air Force senior leaders in selecting AFSC pairs for consolidation. Specifically, the measure of fit will evaluate

potential increases in manpower efficiencies due to cross-trained personnel and potential costs due to increased training time.

Research Questions

Research Question 1: What are the costs/benefits associated with consolidating AFSCs?

Research Question 2: What factors are important to consider when identifying these costs/benefits?

Research Question 3: How must these factors be weighted/combined to form a logical basis for cost/benefit analysis?

Research Question 4: Does the information provided by the contractor and HQ AF/A1 contain the data needed to perform the required cost/benefit analysis? If not, can the data be collected and added to the database?

Research Question 5: Based on the collected data, what transformation is needed to predict likely pairings for successful consolidation?

Research Question 6: What AFSC pairs should (or shouldn't) be consolidated?

Assumptions

Assumption 1: The data collected by the contractor is accurate and complete, reflecting all AFSCs.

Assumption 2: The opinions of the SMEs accurately reflect commonality of skills and training across evaluated AFSCs.

Assumption 3: All training courses are assumed to be as efficient as possible. As such, the maximum time needed for a new consolidated training course is the sum of both

previous courses and the minimum time required for a new training course is equal to the length of the longer previous course.

Assumption 4: As this measure of fit is designed as a preliminary decision tool, the researcher will not interview training managers as to the likely length of new training courses. New course lengths will be assumed to be proportional to the previous training times and commonality of training. Future interviews/research will be required to gather more specific timelines. These interviews/research should be conducted by experts in training curricula.

Assumption 5: Potential manpower efficiencies will be assumed to be proportional to commonality of skills, co-assignment data and the number of personnel in the affected AFSCs. Future interviews/research will be required to gather more specific efficiency data. These interviews/research should be conducted by manpower experts.

Limitations

Limitation 1: Based on the fact that the contract was in progress prior to the researcher's involvement, the researcher will limit the scope of the output to include no new survey data.

Limitation 2: The researcher will not request new data from the contractor so as to not increase the cost on the pre-existing contract (any requests for new data will go through AF/A1 or AFPC directly).

Implications

When successfully completed, this research will allow Air Force senior leaders to more easily identify AFSC pairs for consolidation. If the conclusions of this research are

implemented, they could dramatically reduce the time required to analyze these pairs and result in a more comprehensive list of pairs that could successfully consolidate.

Furthermore, application of this model will allow Air Force senior leaders to achieve any one of four possible objectives:

- Reduce the deployment strain on overburdened AFSCs by increasing the pool of potential deployers with the skills needed to fulfill the mission requirements

- Reduce the strain on the PCS budget by increasing the number of personnel with high-demand skills

- Reduce the operations tempo at base level by increasing the number of personnel capable of fulfilling mission requirements (without increasing overall endstrength)

- Reduce overall endstrength with as little impact on base-level operation tempo as possible

II. Literature Review

Problem and Context

While Air Force career field mergers have not historically followed a rigorous methodology, mergers between corporations and the effects of cross-training employees have received their fair share of study. Within the context of these studies, researchers have used queuing theory extensively to model the benefits associated with consolidation. In such models, researchers treat each skill as a separate queue, not allowing customers to jockey between lines because the servers can accomplish only one type of task. Once cross trained, the researchers combine the queues because the servers now have the skills required to serve both customer sets. Moreover, the goal of corporate skill consolidation tends to be to either reduce wait time for customers (raise service levels) or to hold wait times constant while reducing the overall number of servers (reduce costs) (Pinker and Shumsky, 2000).

Since both of these reasons help the corporation to gain or maintain a competitive advantage, it makes sense that they spend time and money to make sure they complete a thorough study. Comparing these goals to the four objectives listed at the end of Chapter I, there are clear parallels (objectives 1, 2 and 3 address increasing service levels while objectives 2 and 4 address reducing costs); therefore comparing AFSCs (and the service they provide) to queues (from a goal perspective) is warranted.

Because AFSC skills are distinct, customers are not able to jockey (similar to the research on corporate skills). Additionally, there is no other place in the Air Force to go to get the service that an AFSC provides, which means the Air Force customers may not

balk or renege. Finally, just like in a queuing system, the wait time for customers in the Air Force is reliant on the number of servers, the arrival rate and the service time. Therefore, comparing these studies to AFSC consolidation is also valid from a definitional perspective.

Even though these studies tend to focus on corporations much smaller in scale that the Air Force, the insights gained by analyzing them still have application to the problem addressed in this research. Since the Air Force divides its workforce among many geographically separated bases, analyzing the Air Force as if it were one single, large entity could create errors in the model that analysis at a smaller level could avoid. However, despite the differences in scale, the similarities of consolidation in the Air Force and corporations are compelling and analyzing cross-training in corporations could therefore shed some light on the problems addressed in this research.

Comparing Cross-Trained Workers to Specialists

In 2000, Pinker and Shumsky studied "the trade-off between the cost efficiency provided by cross-trained or generalist workers and the experience-based quality provided by specialists" (Pinker and Shumsky, 2000:33); specifically, they looked to determine an optimal mix of cross-trained to specialized workers in a banking call center. Throughout their research, they worked under the assumption that while specialized workers could perform higher quality work (because of a greater level and complexity of experience), cross-trained workers are more efficient for the company (fewer workers are needed in the long run due to the sharing of a common queue). In the end, Pinker and Shumsky established a model where the optimal mixture was primarily dependent on the

number of employees and number of customers served in each of the specialized fields (system size) and the level of complexity for each of the fields (learning rate). However, they were able to make some general conclusions about the mixture of specialized and cross-trained workers (see Table 1).

Table 1: General Conclusions for Specialized/Cross-Trained Employee Mixture (Pinker and Shumsky, 2000:32)

System Size	Learning Rate	Optimal Staff
Small	Slow	Cross-Trained
	High	Mixed
Large	High	Specialized

Since the purpose of any AFSC consolidation is to completely merge the affected career fields, the focus of this research is to consider whether a 100% cross-trained workforce is more efficient than a 100% specialized workforce; in other words, a mixed staff will not be considered a viable solution.

In explaining their model, Pinker and Shumsky presented an example with two identical customer sets (a symmetric system) and looked to determine the cost of staffing per customer arrival. Through their model, they were able to determine that a 100% specialized workforce cost the company $2.00 per customer, while a 100% cross-trained workforce cost the company approximately $1.83 per customer (see Figure 1). From this data, Pinker and Shumsky (2000:41) conclude that "flexible workers are more efficient, in the sense that the same throughput can be achieved with fewer workers." Specifically,

the data (from this example) show a potential efficiency savings of 8.5% over the all-specialist system.

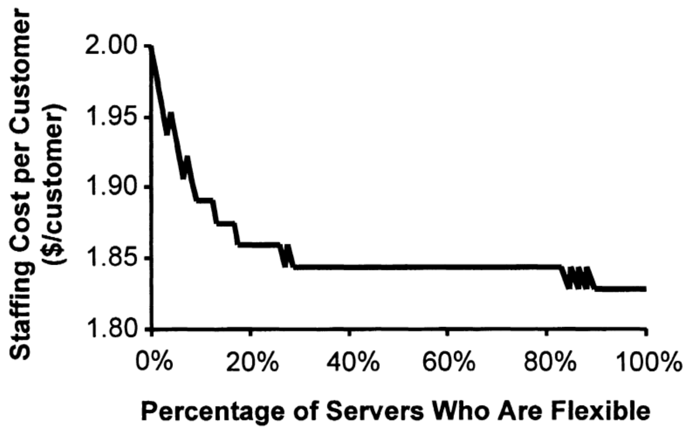

Figure 1: Labor Costs per Customer as the Number of Flexible Workers Varies (Pinker and Shumsky, 2000:41)

Workforce Optimization

One of the potential drawbacks of cross-training workers is maintaining each worker's proficiency in all of the required tasks. To this end, Eitzen and Panton published a study in 2004 in which they addressed the problem of generating worker schedules based on completing multiple tasks with various skill level requirements. The challenge the subject of the study was facing involved balancing the need to maintain workers' skill levels while minimizing scheduled overtime. Due to the complexity of the model, and the need for a high level of detail at the worker/customer level, the models they recommend are not relevant for this study; however, one of the conclusions of the study is that scheduling becomes problematic as the number of tasks (and skill levels) increases (Eitzen and Panton, 2004:359). As such, the authors demonstrate that consolidation is not always beneficial to a company. In order to mitigate this problem,

commonality of skills will be considered in the model for this research so as to increase the likelihood of success in the AFSC consolidation by reducing the number of disparate tasks for the merged career field.

Human Factor Considerations

Another issue to consider within the context of AFSC consolidation is the possible misassignment of employees to jobs. Specifically, merging AFSCs in such a way that some individuals are not qualified to do the new, combined job, or personal issues (jealousy, disinterest, turf protection) cause individuals to perform in a non-efficient manner. Eiselt and Marianov address this problem in their 2008 study. While this study focuses mainly on job satisfaction, the authors address issues such as workload on individuals as well as disparity of workload between individuals. Each of these must be addressed in this research because, as Eiselt and Marianov conclude, significant reduction in employee satisfaction due to misassignment of jobs could result in reduced efficiency because of absenteeism, formal grievances and generally deteriorating labor relations (Eiselt and Marianov, 2008:513). According to the authors, however, these problems can be mitigated through training. Of course, there is a cost associated with this training, both financial and performance based.

Prior to the more formal studies of Eiselt and Marianov, Galosy drafted an article in 1990 based on her experiences as a human resources professional. Specifically, she identified nine losses faced by employees when companies merge (Galosy, 1990:90).

> Hierarchical status – often the acquirer becomes the boss
> Knowledge of firm – procedures and people change
> Trusted subordinates – people tend to be shifted around
> Network – new connections formed

Control – acquirers usually make the decisions
Future – no one knows what will happen
Job definition – most things are in flux for a while
Physical location – moving is typical in mergers
Friends or peers – often people leave, are fired, or transfer

While a merger is not exactly the same as an AFSC consolidation, the sense of loss can be very similar, and therefore the losses identified by Galosy need to at least be considered because, as Galosy states, "such losses can create a state of acute anxiety in the workforce (Galosy, 1990:90)."

Potential Inefficiencies

While much research has been devoted to the idea that combining queues is beneficial in terms of both reducing costs and increasing customer service, there are instances when combining queues may be counterproductive. Specifically, Rothkopf and Rech noted that moving to a single-queue system may cause depersonalization in the server-customer relationship because customers would be less able to choose servers. This depersonalization could then lead to a decreased sense of satisfaction for both the customer and the server (1987:907). Additionally, Rothkopf and Rech cite a potential for increased service times and additional training costs with a single-queue system that should be addressed before assuming advantages of a combined system (1987:908).

In 2003, Agnihothri et al also cautioned about assuming efficiencies when combining queues. They conclude that while pooling services in a system with homogeneous skills will result in "a more balanced workload among servers" and a reduction in service delay, they state that pooling services in a heterogeneous-skills system will "increase service costs and may reduce service efficiency" (Agnihothri et al, 2003:410). Chakravarthy and Agnihothri continued to caution against an assumption of

benefits with combined queues with their study in 2005. While they cited increased service costs and reduced service efficiencies inherent with cross-trained workers, they also found that a system of 100% flexible workers (as would be the case with an AFSC consolidation) is only beneficial when the relative cost of flexibility (defined as cost associated with cross-training divided by the cost of customer downtime) is low (Chakravarthy and Agnihothri, 2005:226).

Synthesis

As seen through the literature addressed in this chapter, research exists which studies the effect of cross-training employees on the efficiency of an organization; however, there are also costs which need to be considered prior to making a wholesale move away from specialized workers. Specifically, cross-training workers could result in a reduction of overall quality and timeliness of the work performed. There are also costs associated with training employees on multiple skills; both with respect to the time lost in training and the monetary cost of the training. Depending on the level of disparity in the original skills, the costs associated with consolidation could also outweigh the potential benefits. Additionally, efficiencies gained through the merging of skill sets could be offset or erased by the inefficiencies induced through employee dissatisfaction with the new work, unfair allocation of work, or employee anxiety with their perceived losses due to the consolidation. All of these factors must be considered before any model on consolidation will be effective.

Hypothesis

The primary cost associated with consolidating AFSCs is the additional training time required to initially learn two skills instead of one. The primary benefit associated with consolidating AFSCs is having more people available with the required skills to complete tasks from both specialties. The measure of fit proposed by this research will identify AFSC pairs likely for successful consolidation by comparing the costs of training to the benefits of increased availability, resulting in an indexed matrix with which Air Force senior leaders will be able to view relative benefits of proposed consolidations.

III. Methodology

Most of the data required for this project is available through the Air Force Personnel Center (AFPC) and the Military Personnel Data System (MilPDS) and has been previously collected by the contractor. This data includes: AFSC population size, training duration, minimum requirements, number of personnel trained per year and co-assignment data for AFSC pairs. Additionally, the contractor has conducted a survey with SMEs to identify the level of training and skill commonality between all AFSCs with which the SME is familiar. While not all AFSC pairs may be evaluated through the surveys, the SMEs were able to identify a number of pairs with high levels on commonality.

In order to answer the research questions, this research will focus on determining a numerical relationship between the collected data in such a way as to calculate a cost/benefit measure for the merging of specific AFSC pairs. Data utilized to calculate the benefit of a merger will include: career field sizes, commonality of skills, and co-assignment percentages. Additionally, data will be integrated to account for potential efficiencies (or inefficiencies) inherent when two offices combine into one (much like a two-queue system where the queues are merged to form one queue) by including a workload savings coefficient which is designed to account for the efficiencies (and inefficiencies) that occur based on the similarities (or dissimilarities) of skill sets. Data utilized to calculate the cost of the merger will include: size of the annual training pipelines for each of the affected AFSCs, commonality of training, and duration of the original training courses. Together, these data will reveal a ratio of efficiencies gained to

additional training required. If the ratio is greater than one, merging the AFSCs could result in an overall gain to the Air Force; conversely, a ratio of less than one indicates that the costs of a merger would likely be greater than the potential benefit.

Method Used

There are numerous data available to consider when evaluating AFSC pairs for consolidation. In fact, there are so much available data, any one person can easily become overwhelmed. In order to consolidate the data, this research will utilize factor analysis to create a transformation algorithm of the underlying data into a manageable and understandable set of records.

Underlying Data

Before describing the formulation of the model, one must first understand the data that is being used within the factor analysis and how it was gathered. Most of the data gathered for this research was pulled directly from the Air Force's main personnel data system, MilPDS. This data includes:

- Number of personnel in each AFSC
- Number of personnel trained in each AFSC per year
- Course length for initial training for each AFSC
- Percentage of positions for each AFSC pair that are assigned to the same base

Additionally, the contractor has compiled survey data from SMEs that enumerate the commonality of skills and training for each of the AFSC pairs.

While this data is all important in computing a likelihood of success for consolidating AFSCs, no one element can reliably predict if the outcome would be

beneficial to the Air Force. It will take a combination of the data to produce such a measure.

Mathematical Formulation of the Model

The first step in building the model is to calculate the benefit of the consolidation; essentially, the model will have to estimate the potential efficiencies gained by combining the AFSCs in question. To do this, we will define the following variables to represent the required data:

ϕ = Co-assignment coefficient (the probability that one AFSC will be assigned to a base given that the other AFSC is assigned there)
ω = Workload savings coefficient (potential efficiencies gained as a result of consolidation, given as a percentage of original manpower levels)
γ_s = Average skills rating from survey (opinion of SMEs, scaled from 1 to 5)
λ_1 = Total personnel in first AFSC (x 1,000)
λ_2 = Total personnel in second AFSC (x 1,000)

While λ_1 and λ_2 are unique to each AFSC, γ_s and ϕ are unique to each AFSC pair.

Below is the formula used to calculate the potential manpower efficiencies (ε):

$$\varepsilon = 1{,}000\phi\omega\left(\frac{(\gamma_s - 1)}{4}\right)\left(min(\lambda_1, \lambda_2)\right)$$

where:

- ϕ isolates only those members within the AFSC pair that are stationed together (because one worker cannot help or pick up the work of another if both workers are not located in the same geographic area)
- ω = 8.5% (based on research by Pinker and Shumsky in 2000)
- $\left(\frac{(\gamma_s - 1)}{4}\right)$ translates a 1-5 scaled ranking to a 0 - 100% factor
- $\left(min(\lambda_1, \lambda_2)\right)$ finds the smaller career field (in thousands)

- the formula is multiplied by 1,000 to convert the number of affected personnel from thousands to ones.

Once ε is determined, the next step in the model is to calculate the cost of the consolidation. For the purposes of this model, we will consider the cost of consolidation to be the additional training time required to initially train personnel in two specialties instead of only one. Considerations for this calculation include:

τ_1 = Training time for first AFSC (in years)
τ_2 = Training time for second AFSC (in years)
γ_t = Average training rating from survey (opinion of SMEs, scaled from 1 to 5)
η_1 = Personnel trained in first AFSC (per year)
η_2 = Personnel trained in second AFSC (per year)

While τ_1, η_1, τ_2, and η_2 are unique to each AFSC, γ_t is unique to the AFSC pair. Below are the formulas used to calculate the additional man-years required for consolidated training (μ):

$$\mu_{\min} = \left(max(\tau_1, \tau_2)\right)\left(\eta_1 + \eta_2\right) - \tau_1\eta_1 - \tau_2\eta_2$$

$$\mu_w = \left(\left(\tau_1 + \tau_2\right) - \left(\frac{(\gamma_t - 1)}{4}\right) min(\tau_1, \tau_2)\right)\left(\eta_1 + \eta_2\right) - \tau_1\eta_1 - \tau_2\eta_2$$

$$\mu_{\max} = \left(\tau_1 + \tau_2\right)\left(\eta_1 + \eta_2\right) - \tau_1\eta_1 - \tau_2\eta_2$$

Each of these calculations is dependent upon the length of the new, consolidated training course.

$$\tau_{\min} = min\left(\tau_1, \tau_2\right)$$

$$\tau_w = \left(\tau_1 + \tau_2\right) - \left(\frac{(\gamma_t - 1)}{4}\right) min(\tau_1, \tau_2)$$

$$\tau_{\max} = \tau_1 + \tau_2$$

These equations are represented graphically in Figure 3 with notional courses of length τ_i and τ_j.

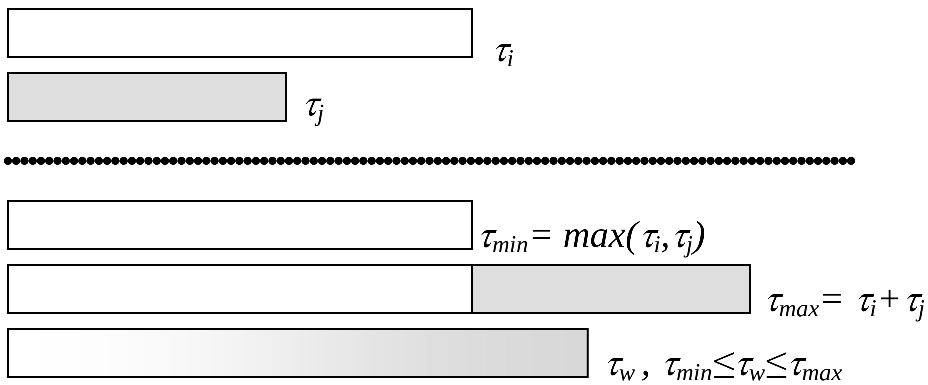

Figure 2: Representation τ_{min}, τ_w, τ_{max}.

In calculating τ_{min}, the duration of the new training course is assumed to be equal to the duration of longer of the previous training courses. Since we have previously assumed that all training courses are as efficient as possible, this duration makes sense to be applied as the minimum training time for the new course, even though it is highly unlikely that the new course will be this short. Similarly, the τ_{max} calculation estimates the duration of the new training course to be equal to the sum of the previous two training courses. This is also not a likely duration for the new course because there are likely to be some basic principles in each course that would overlap and therefore there would be room to condense at least some training time, but it provides a sensible upper bound for the new training course length. The calculation of τ_{w} represents a weighted estimation of the new training course length.

When calculating μ_w, we must take first start with the maximum training length for the new course (τ_{max}) and subtract from it a weighted factor which represents an estimation of the commonality of training. Similar to the previous calculation of ε, this calculation converts the 1-5 scaling of γ_t to a 0 - 100% weighting factor. This percentage is then multiplied by the shorter of the two previous training courses, then the product $\left(\left(\frac{(\gamma_t - 1)}{4}\right) min(\tau_1, \tau_2)\right)$ is subtracted from the previous training time ($\tau_1 + \tau_2$), giving us an estimation of the new training time.

In all of the calculations of μ, the new training time is multiplied by the total number of trainees in the new, combined AFSC, resulting in the man-years of training for the new AFSC. From that product, we subtract the man-years of training for each of the previous AFSCs $(\tau_1\eta_1 + \tau_2\eta_2)$. The resulting calculation of μ determines how many additional man-years of training the new AFSC will require.

Now that we have calculated the potential manpower efficiencies (ε) and the additional man-years required for consolidated training (μ), we can find a cost/benefit ratio based on these numbers. We will call this ratio the manpower-training ratio (ρ) and define it as:

$$\rho = \varepsilon/\mu = \text{Manpower-Training Ratio}$$

Depending on which value of μ is used, ρ can take on up to three values defined as:

$$\rho_{\max} = \frac{\varepsilon}{\mu_{\min}} \qquad \rho_w = \frac{\varepsilon}{\mu_w} \qquad \rho_{\min} = \frac{\varepsilon}{\mu_{\max}}$$

Even though we could calculate all three values of ρ in the data analysis, this model will use ρ_w as the main indicator because we have a fair idea of the commonality of training. In fact, the proofs below show that ρ_{min} and ρ_{max} can be derived from ρ_w.

If commonality of training (γ_t) = 1 (if there are no common elements within the training course from the previous AFSCs), then:

$$\begin{aligned}
\mu_w &= \left((\tau_1 + \tau_2) - \left(\frac{(\gamma_t - 1)}{4} \right) min(\tau_1, \tau_2) \right) (\eta_1 + \eta_2) - \tau_1\eta_1 - \tau_2\eta_2 \\
&= \left((\tau_1 + \tau_2) - \left(\frac{(1 - 1)}{4} \right) min(\tau_1, \tau_2) \right) (\eta_1 + \eta_2) - \tau_1\eta_1 - \tau_2\eta_2 \\
&= \left((\tau_1 + \tau_2) - (0) min(\tau_1, \tau_2) \right) (\eta_1 + \eta_2) - \tau_1\eta_1 - \tau_2\eta_2 \\
&= \left((\tau_1 + \tau_2) - 0 \right) (\eta_1 + \eta_2) - \tau_1\eta_1 - \tau_2\eta_2 \\
&= (\tau_1 + \tau_2)(\eta_1 + \eta_2) - \tau_1\eta_1 - \tau_2\eta_2 \\
&= \mu_{max}
\end{aligned}$$

Similarly, if commonality of training (γ_t) = 5 (the two courses have identical training elements), then:

$$\begin{aligned}
\mu_w &= \left((\tau_1 + \tau_2) - \left(\frac{(\gamma_t - 1)}{4} \right) min(\tau_1, \tau_2) \right) (\eta_1 + \eta_2) - \tau_1\eta_1 - \tau_2\eta_2 \\
&= \left((\tau_1 + \tau_2) - \left(\frac{(5 - 1)}{4} \right) min(\tau_1, \tau_2) \right) (\eta_1 + \eta_2) - \tau_1\eta_1 - \tau_2\eta_2 \\
&= \left((\tau_1 + \tau_2) - (1) min(\tau_1, \tau_2) \right) (\eta_1 + \eta_2) - \tau_1\eta_1 - \tau_2\eta_2 \\
&= \left((\tau_1 + \tau_2) - min(\tau_1, \tau_2) \right) (\eta_1 + \eta_2) - \tau_1\eta_1 - \tau_2\eta_2 \\
&= \left(max(\tau_1, \tau_2) \right) (\eta_1 + \eta_2) - \tau_1\eta_1 - \tau_2\eta_2 \\
&= \mu_{min}
\end{aligned}$$

Since both μ_{max} and μ_{min} can be derived from μ_w, and therefore ρ_{min} and ρ_{max} can be derived from ρ_w, it is sensible to use ρ_w as the principal indicator for the model.

Interpreting the Model

Now that we have determined a value for ρ_w for each of the AFSC pairs, we can begin to assess likelihood of success for the proposed AFSC consolidations. As stated earlier, we want to find AFSC pairs where the potential benefit of the consolidation will outweigh the likely costs. In this model, the benefit has been defined as the potential manpower efficiencies (ε) and the cost has been defined as the additional man-years required for consolidated training (μ). Therefore, we want to identify AFSC pairs whose potential manpower efficiencies are greater that the additional man-years required for consolidated training. In other words, we are looking to select AFSC pairs with a $\rho_w > 1$ (the greater the value of ρ_w, the better the potential gains) and avoid AFSC pairs with a $\rho_w < 1$ (the likely cost of training outweighs the benefit of efficiencies at the base level).

IV. Results and Analysis

Determining AFSC Pairs

In order to assess the viability of AFSC pairs for consolidation, the contractor distributed a survey to SMEs across the Air Force, requesting their opinions on the similarity of skills and similarity of training for all AFSCs in the Air Force. The SMEs were asked to respond only to those AFSCs with which they have extensive knowledge or experience. As such, many AFSC pairs received no ratings because the skills and training curricula were so disparate that no (or few) respondents had enough experience in both fields to form an educated opinion. In fact, with 222 total AFSCs, there are over 49,000 possible AFSC pairs to be merged. Of those possible AFSC pairs, only 4,111 were evaluated, with 2,305 being evaluated by only one SME (see Table 2).

Table 2: AFSC Pair Evaluations

# Evaluations by SMEs	# AFSC Pairs
0	44,951
1	2,305
2	707
3	314
4	196
> 4	589

In order to minimize the bias of just one evaluator, the contractor compiled data of AFSC pairs that had at least 2 evaluators. This reduced the possible AFSC pairings to 1,806. This number was further reduced by only considering the 70 highest scoring AFSC pairs (with rare exception, these pairs each had combined scores of $\gamma_s + \gamma_t > 5.0$) because it was felt these AFSC pairs held the greatest likelihood of finding AFSC pairs capable of merging.

With the field of AFSC pairs reduced to a manageable number, the next task was to determine the possible efficiencies to be gained by merging the AFSC.

Determining Potential Manpower Efficiencies

As discussed in the Methodology section, potential manpower efficiencies (ε) are defined as:

$$\varepsilon = 1,000\phi\omega\left(\frac{(\gamma_s - 1)}{4}\right)\left(min(\lambda_1, \lambda_2)\right)$$

where:

- ϕ is the co-assignment coefficient
- ω (the workload savings coefficient) = 8.5%
- $\left(\frac{(\gamma_s - 1)}{4}\right)$ translates a 1-5 scaled ranking to a 0 - 100% factor
- $\left(min(\lambda_1, \lambda_2)\right)$ finds the smaller career field (in thousands)

Therefore, for each AFSC pair,

$$\varepsilon = 85\phi\left(\frac{(\gamma_s - 1)}{4}\right)\left(min(\lambda_1, \lambda_2)\right)$$

Potential manpower efficiencies are listed in Appendix A for all considered AFSC pairs.

Determining Potential Training Costs

Now that we have the potential manpower efficiencies, the next step is to determine the potential training costs. As discussed in the Methodology section, the potential training costs, defined as additional man-years required for consolidated training (μ_w), are:

$$\mu_w = \left(\left(\tau_1 + \tau_2 \right) - \left(\frac{(\gamma_t - 1)}{4} \right) min(\tau_1, \tau_2) \right) \left(\eta_1 + \eta_2 \right) - \tau_1 \eta_1 - \tau_2 \eta_2$$

where:

τ_1 = Training time for first AFSC (in years)
τ_2 = Training time for second AFSC (in years)
γ_t = Average training rating from survey (opinion of SMEs, scaled from 1 to 5)
η_1 = Personnel trained in first AFSC (per year)
η_2 = Personnel trained in second AFSC (per year)

In order to break this into more manageable pieces, we can first look at calculating the length of the new training course (τ_w), which is given by:

$$\tau_w = \left(\tau_1 + \tau_2 \right) - \left(\frac{(\gamma_t - 1)}{4} \right) min(\tau_1, \tau_2)$$

Potential new training lengths are listed in Appendix B for all considered AFSC pairs.

Now that we have results for the potential training times for the combined courses, we must use this data to calculate the potential additional man-years (μ_w)

involved in training the merged AFSCs. Since we know from the Methodology section that:

$$\mu_w = \left((\tau_1 + \tau_2) - \left(\frac{(\gamma_t - 1)}{4} \right) min(\tau_1, \tau_2) \right) (\eta_1 + \eta_2) - \tau_1 \eta_1 - \tau_2 \eta_2$$

we can then substitute for τ_w and find

$$\mu_w = \tau_w (\eta_1 + \eta_2) - \tau_1 \eta_1 - \tau_2 \eta_2$$

Because of annual fluctuations in the number of students trained in each AFSC, we will use a figure for η that is equal to 8% of the total population of the career field (the data for 2006-2007 showed an 8% training ratio across all AFSCs). Potential additional man-years required for consolidation are listed in Appendix C for all considered AFSC pairs.

Determining Manpower-Training Ratio

Now that we have both the potential efficiencies of consolidation (ε) and the potential costs associated with combining the training courses (μ), we are ready to see if consolidating the AFSC pairs would be beneficial in the long run. In order to do this, we much find the manpower-training ratio (ρ), which is defined as:

$$\rho = \varepsilon / \mu$$

If we find $\rho > 1$, there are potential benefits associated with the merger. If $\rho < 1$, the cost (defined as additional training time) would likely outweigh any gains that would be realized by the consolidation. Calculations for the manpower-training ratio are listed in Appendix D for all considered AFSC pairs.

Analysis

After calculating ρ for all AFSC combinations, the number of potentially beneficial consolidations has been reduced to only 19 from the original 49,062, representing 0.0387% of all possible combinations. A more consolidated breakout of ρ-values is listed in Table 3 and a graphical representation is in Figure 3.

Table 3: Breakout of ρ-values

ρ-value	# occurrences
$\rho \leq 1$	51
$1 < \rho \leq 1.5$	5
$1.5 < \rho \leq 2$	3
$\rho > 2$	11

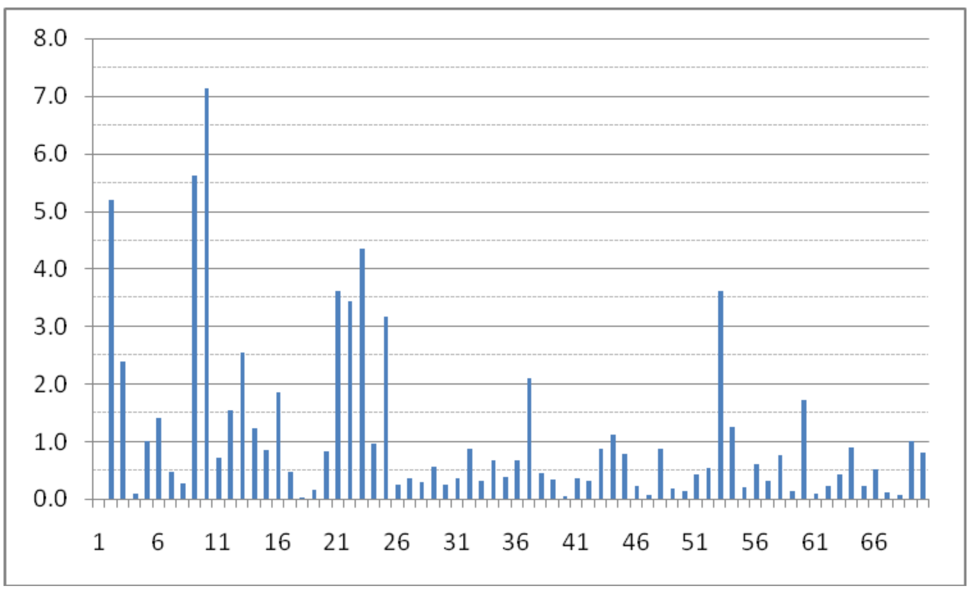

Figure 3: Graph of values of ρ

Because the relative benefit of consolidation increases as ρ increases, it is recommended that consolidation efforts focus on the AFSC pairs with the highest value of ρ, working down until either the desired objectives are met (see Chapter I) or until all pairs with $\rho > 1$ are exhausted. Given the data in this study, Table 4 lists the potential manpower efficiencies that would be gained.

Table 4: Potential Manpower Efficiencies from AFSC Pairs

AFSC Pair	Potential Manpower Efficiencies	Additional Training Man-Years	Weighted Manpower/ Training Ratio
10	97	14	7.132
9	9	2	5.625
2	6	1	5.200
23	14	3	4.354
21	10	3	3.611
53	2	1	3.611
22	10	3	3.439
25	7	2	3.160
13	540	212	2.544
3	119	50	2.387
37	37	18	2.097
16	106	58	1.843
60	25	15	1.707
12	9	6	1.548
6	38	27	1.415
54	41	33	1.242
14	7	6	1.236
44	9	8	1.110
Total	1,086	462	

V. Discussion

Answers to Research Questions

Research Question 1: What are the costs/benefits associated with consolidating AFSCs?

Answer: As stated in the previous research, the most common costs associated with private-sector consolidations are reduced customer service through loss of job specialization and the monetary and time costs associated with the additional training. Similarly, benefits in these studies are measured in reduced waiting times for customers (if the number of servers remains constant) or reduction in the number of servers required (to maintain the same level of service). Since the monetary costs of the additional training vary with the specific skill sets (due to complexity of tasks, location of training, etc.), this research focuses on time as both a cost and a benefit of consolidation. By using time as an objective measure, this research is able to mitigate the effect associated with varying costs and produce a measure of fit with a relative cost/benefit.

Research Question 2: What factors are important to consider when identifying these costs/benefits?

Answer: In order to calculate the cost/benefits ratio, important factors include: AFSC populations, AFSC annual student populations, AFSC training length, commonality of skills between AFSC pairs, commonality of training between AFSC pairs, and likelihood of assignment at the same base among AFSC pairs (co-assignment coefficient).

Research Question 3: How must these factors be weighted/combined to form a logical basis for cost/benefit analysis?

Answer: The factors needed to find potential manpower efficiencies are: AFSC populations, commonality of skills between AFSC pairs, and co-assignment coefficient. The factors needed to find the additional training man-years are: AFSC annual student populations, AFSC training length, and commonality of training between AFSC pairs.

Research Question 4: Does the information provided by the contractor and HQ AF/A1 contain the data needed to perform the required cost/benefit analysis? If not, can the data be collected and added to the database?

Answer: The original data did not provide the number of students trained annually in each of the AFSCs. This data was later provided by HQ AF/A1 for fiscal year 2006 and averaged to account to annual fluctuations in training levels.

Research Question 5: Based on the collected data, what transformation is needed to predict likely pairings for successful consolidation?

Answer: Based on the provided data, it was determined that a ratio of benefits to costs would provide the best prediction for successful consolidation. For this ratio, the benefit established as the potential manpower efficiencies gained through consolidation, while the costs was represented by the additional man-years that would be required by the combined training.

Research Question 6: What AFSC pairs should (or shouldn't) be consolidated?

Answer: Based on the results from Chapter IV, there are at most 19 AFSC pairs that should be considered for consolidation. The specific AFSCs associated with these pairs are not listed because that data is considered "For Official Use Only." That data will be provided to the sponsor, HQ AF/A1.

Relevance of Research

This research has opened the door to a new method for determining viable AFSC pairs for consolidation. It has shown the potential benefits of consolidation, while acknowledging the inherent costs. It has also removed a great deal of subjectivity from an almost entirely opinion-based process and replaced it with an objective, analytic process with greatly lessened bias.

Recommended Future Research

While the SME opinion surveys are a good starting point for this objective measure of fit, it is not optimal because of the subjective nature of the surveys and the fact that only 1,806 of over 49,000 possible AFSC combinations were evaluated by more than one SME. Therefore, efforts should be made to evaluate all AFSC combinations by compiling data that is available for all AFSC through the military personnel data systems. By finding data that could be combine into measures similar to γ_s ans γ_t, this future research could open the possibility of evaluating all AFSC combinations with minimal manpower expenditure and without subjective biases. It would also open the possibility of evaluating AFSC mergers on an almost continuous basis, versus the current process of evaluating mergers only periodically.

Conclusions

Admittedly, this research does not capture all of costs and benefits associated with AFSC mergers, nor it is a crystal ball that will give definitive answers as to exact manpower savings and additional training man-hour required as a result of merging specific AFSC pairs. It does, however, serve as a guide for Air Force senior leaders. By

utilizing this research, Air Force senior leaders will be able to evaluate multiple AFSC pairings and narrow down over 49,000 possible AFSC mergers into a much more manageable 19 pairings. They can then look over the preliminary data and forward their recommendations to manpower and training experts to further refine the data. After they receive the data back from the manpower and training experts, they can review the findings and begin the task of merging the remaining AFSC pairs.

This research removes a significant portion of subjectivity from the AFSC consolidation process, replacing it with a more objective measure of potential success. Employing this method will give Air Force senior leaders a scaled, objective measure of fit to aid in selecting AFSC pairs for consolidation—dramatically reducing the time required to analyze AFSC pairs and resulting in a more comprehensive list of AFSC pairs that could successfully consolidate.

Appendix A: Potential Manpower Efficiencies

AFSC Pair	Co- Assignment	Skills Rating	Population 1 ('000s)	Population 2 ('000s)	Potential Manpower Efficiencies
	ϕ	γ_s	λ_1	λ_2	ε
1	0	4.3	0.2	2	0
2	0.47	4.2	0.2	1.3	6
3	0.69	4.3	2.5	3.3	119
4	0.53	3.4	0.08	2.2	2
5	0.14	4.3	0.6	2	6
6	0.60	3.7	1.1	1.7	38
7	0.14	4.1	1.3	0.5	5
8	0.55	4.6	0.6	26.7	25
9	0.40	3.0	0.6	0.5	9
10	0.72	3.6	2.4	2.8	97
11	0.26	3.7	2.6	1.6	24
12	0.54	3.5	0.3	1.5	9
13	0.85	3.7	11.1	11.2	540
14	0.52	3.2	0.3	2	7
15	0.63	3.9	6.6	2.6	102
16	0.84	3.5	2.4	2.5	106
17	0.63	3.6	9.1	3.3	114
18	0.58	4.4	0.1	26.7	4
19	0.27	3.7	0.9	12	14
20	0.64	3.2	1.7	3.3	52
21	0.75	3.1	0.3	0.6	10
22	0.79	3.1	0.3	0.6	10
23	0.64	3.0	0.6	0.5	14
24	0.33	3.1	9.1	10.2	136
25	0.61	2.9	0.3	0.5	7
26	0.33	3.1	2.5	9.1	37
27	0.35	3.5	3.7	0.9	17
28	0.22	3.4	2.4	0.9	10
29	0.23	3.3	0.7	2.4	8
30	0.37	3.5	6.6	1.6	31
31	0.39	3.1	0.6	7.2	10
32	0.68	3.2	4.4	2.6	81
33	0.33	3.2	6.7	2.5	39
34	0.68	3.4	1.2	0.8	28
35	0.33	3.1	2.3	0.9	13
36	0.64	3.0	5.5	2.3	63
37	0.65	3.2	2.5	1.2	37
38	0.59	2.9	4.8	2.3	54
39	0.19	2.8	0.2	0.5	1
40	0.20	3.0	8.6	0.7	6
41	0.19	3.0	1	1.4	8
42	0.46	3.0	0.7	3.3	14
43	0.64	2.8	2.5	1.7	42
44	0.33	2.9	1	0.7	9
45	0.63	3.0	2.4	2.9	64
46	0.31	2.8	0.4	2.1	5
47	0.30	3.0	0.9	8.6	12
48	0.44	3.0	0.9	1.5	17
49	0.27	2.8	0.4	1.7	4
50	*0.35*	3.0	2.8	0.3	4
51	0.28	2.8	0.9	0.7	7
52	0.25	2.8	1	2.4	9
53	0.18	3.0	0.3	0.2	2
54	0.65	3.0	1.5	4.8	41
55	0.25	1.6	2.4	1.8	6
56	0.32	2.2	1.3	2.4	11
57	0.24	2.2	1	1.3	6
58	0.79	2.3	3.3	0.9	20
59	0.29	2.7	3.3	1.8	19
60	0.81	2.8	0.8	0.8	25
61	0.50	2.5	6.7	0.4	6
62	0.62	2.3	7.6	0.4	7
63	0.21	2.6	1.5	3.3	11
64	0.85	2.4	1.2	0.8	20
65	0.37	2.2	2.1	3.3	20
66	0.33	2.7	0.7	0.8	8
67	0.40	2.5	0.5	10.2	6
68	0.63	1.5	1.4	8.6	9
69	0.52	2.8	0.8	1.4	16
70	0.54	2.9	1.4	7.2	30

Appendix B: Potential New Training Lengths

AFSC Pair	Training Rating	Training Time 1 (yrs)	Training Time 2 (yrs)	New Training - Weighted (yrs)
	γ_t	τ_1	τ_2	τ_w
1	4.7	0.269	0.038	0.273
2	4.6	0.09	0.09	0.098
3	4.3	0.31	0.42	0.481
4	4.8	0.25	0.12	0.256
5	3.9	0.11	0.11	0.140
6	4.3	0.29	0.46	0.513
7	3.7	0.12	0.17	0.208
8	3.2	0.09	0.09	0.135
9	4.7	0.10	0.12	0.127
10	3.8	0.11	0.11	0.140
11	3.6	0.29	0.29	0.388
12	3.8	0.13	0.13	0.167
13	3.6	0.18	0.29	0.352
14	3.9	0.11	0.11	0.142
15	3.1	0.18	0.29	0.373
16	3.4	0.35	0.29	0.463
17	3.2	0.21	0.42	0.517
18	2.3	0.09	0.09	0.154
19	3.0	0.18	0.18	0.265
20	3.5	0.27	0.42	0.527
21	3.5	0.10	0.10	0.138
22	3.5	0.11	0.11	0.152
23	3.6	0.10	0.10	0.137
24	3.4	0.21	0.14	0.267
25	3.6	0.10	0.10	0.135
26	3.3	0.31	0.21	0.396
27	3.0	0.25	0.25	0.377
28	3.0	0.35	0.18	0.435
29	3.1	0.12	0.11	0.169
30	2.8	0.18	0.29	0.385
31	3.1	0.10	0.10	0.146
32	3.0	0.35	0.29	0.490
33	2.9	0.35	0.29	0.496
34	2.7	0.11	0.44	0.504
35	3.0	0.35	0.18	0.435
36	3.0	0.11	0.25	0.306
37	2.8	0.11	0.11	0.167
38	3.1	0.12	0.35	0.406
39	3.2	0.12	0.12	0.173
40	3.0	0.07	0.27	0.304
41	3.0	0.23	0.23	0.346
42	2.9	0.27	0.27	0.413
43	3.1	0.31	0.27	0.437
44	3.0	0.12	0.12	0.179
45	2.8	0.35	0.18	0.446
46	3.0	0.15	0.36	0.433
47	2.7	0.26	0.07	0.296
48	2.8	0.12	0.22	0.281
49	3.0	0.15	0.46	0.537
50	2.8	0.11	0.18	0.238
51	3.0	0.26	0.26	0.390
52	3.0	0.12	0.11	0.173
53	5.0	0.10	0.12	0.119
54	3.0	0.13	0.12	0.187
55	1.8	0.12	0.11	0.206
56	2.7	0.09	0.12	0.169
57	2.3	0.17	0.09	0.225
58	2.5	0.17	0.10	0.233
59	1.8	0.42	0.46	0.800
60	2.7	0.21	0.13	0.283
61	3.2	0.04	0.13	0.152
62	3.2	0.23	0.09	0.273
63	3.0	0.09	0.17	0.210
64	3.0	0.09	0.25	0.298
65	3.0	0.37	0.42	0.606
66	3.0	0.25	0.13	0.313
67	3.0	0.11	0.14	0.200
68	3.0	0.25	0.07	0.285
69	3.0	0.10	0.21	0.262
70	2.9	0.10	0.10	0.154

Appendix C: Potential Additional Man-Years Required for Consolidation

AFSC Pair	Students 1	Students 2	Training Time 1 (yrs)	Training Time 2 (yrs)	New Training - Weighted (yrs)	Additional Training Man-Years
	η_1	η_2	τ_1	τ_2	τ_w	μ_w
1	16	160	0.269	0.038	0.273	38
2	16	104	0.09	0.09	0.098	1
3	200	264	0.31	0.42	0.481	50
4	6.4	176	0.25	0.12	0.256	23
5	48	160	0.11	0.11	0.140	6
6	88	136	0.29	0.46	0.513	27
7	104	40	0.12	0.17	0.208	11
8	48	2136	0.09	0.09	0.135	92
9	48	40	0.10	0.12	0.127	2
10	192	224	0.11	0.11	0.140	14
11	208	128	0.29	0.29	0.388	34
12	24	120	0.13	0.13	0.167	6
13	888	896	0.18	0.29	0.352	212
14	24	160	0.11	0.11	0.142	6
15	528	208	0.18	0.29	0.373	121
16	192	200	0.35	0.29	0.463	58
17	728	264	0.21	0.42	0.517	247
18	8	2136	0.09	0.09	0.154	132
19	72	960	0.18	0.18	0.265	91
20	136	264	0.27	0.42	0.527	62
21	24	48	0.10	0.10	0.138	3
22	24	48	0.11	0.11	0.152	3
23	48	40	0.10	0.10	0.137	3
24	728	816	0.21	0.14	0.267	143
25	24	40	0.10	0.10	0.135	2
26	200	728	0.31	0.21	0.396	152
27	296	72	0.25	0.25	0.377	47
28	192	72	0.35	0.18	0.435	36
29	56	192	0.12	0.11	0.169	15
30	528	128	0.18	0.29	0.385	122
31	48	576	0.10	0.10	0.146	29
32	352	208	0.35	0.29	0.490	93
33	536	200	0.35	0.29	0.496	122
34	96	64	0.11	0.44	0.504	42
35	184	72	0.35	0.18	0.435	38

AFSC Pair	Students 1	Students 2	Training Time 1 (yrs)	Training Time 2 (yrs)	New Training - Weighted (yrs)	Additional Training Man-Years
	η_1	η_2	τ_1	τ_2	τ_w	μ_w
36	440	184	0.11	0.25	0.306	35
37	200	96	0.11	0.11	0.167	96
38	384	184	0.12	0.35	0.406	18
39	16	40	0.12	0.12	0.173	120
40	688	56	0.07	0.27	0.304	3
41	80	112	0.23	0.23	0.346	163
42	56	264	0.27	0.27	0.413	22
43	200	136	0.31	0.27	0.437	46
44	80	56	0.12	0.12	0.179	49
45	192	232	0.35	0.18	0.446	8
46	32	168	0.15	0.36	0.433	81
47	72	688	0.26	0.07	0.296	22
48	72	120	0.12	0.22	0.281	159
49	32	136	0.15	0.46	0.537	20
50	224	24	0.11	0.18	0.238	23
51	72	56	0.26	0.26	0.390	31
52	80	192	0.12	0.11	0.173	17
53	24	16	0.10	0.12	0.119	17
54	120	384	0.13	0.12	0.187	1
55	192	144	0.12	0.11	0.206	33
56	104	192	0.09	0.12	0.169	31
57	80	104	0.17	0.09	0.225	18
58	264	72	0.17	0.10	0.233	19
59	264	144	0.42	0.46	0.800	26
60	64	64	0.21	0.13	0.283	148
61	536	32	0.04	0.13	0.152	15
62	608	32	0.23	0.09	0.273	61
63	120	264	0.09	0.17	0.210	31
64	96	64	0.09	0.25	0.298	26
65	168	264	0.37	0.42	0.606	23
66	56	64	0.25	0.13	0.313	89
67	40	816	0.11	0.14	0.200	16
68	112	688	0.25	0.07	0.285	51
69	64	112	0.10	0.21	0.262	152
70	112	576	0.10	0.10	0.154	16

Appendix D: Manpower-Training Ratio

AFSC Pair	Potential Manpower Efficiencies	Additional Training Man-Years	Weighted Manpower/ Training Ratio
	ε	μ	ρ
1	0	1955	0.000
2	6	60	5.200
3	119	2592	2.387
4	2	1216	0.086
5	6	312	1.000
6	38	1397	1.415
7	5	558	0.466
8	25	4805	0.271
9	9	83	5.625
10	97	707	7.132
11	24	1747	0.714
12	9	302	1.548
13	540	11038	2.544
14	7	294	1.236
15	102	6301	0.842
16	106	2991	1.843
17	114	12869	0.461
18	4	6861	0.030
19	14	4747	0.153
20	52	3248	0.833
21	10	144	3.611
22	10	151	3.439
23	14	167	4.354
24	136	7415	0.954
25	7	115	3.160
26	37	7909	0.243
27	17	2429	0.364
28	10	1848	0.281
29	8	760	0.547
30	31	6342	0.254
31	10	1498	0.347
32	81	4824	0.873
33	39	6341	0.320
34	28	2182	0.667
35	13	1811	0.373
36	63	4978	0.658
37	37	918	2.097
38	54	6255	0.449
39	1	157	0.332
40	6	8494	0.037
41	8	1152	0.361
42	14	2400	0.303
43	42	2523	0.866
44	9	422	1.110
45	64	4208	0.791
46	5	1129	0.230
47	12	8262	0.076
48	17	1027	0.861
49	4	1177	0.177
50	4	1600	0.130
51	7	872	0.417
52	9	877	0.534
53	2	29	3.611
54	41	1716	1.242
55	6	1598	0.195
56	11	936	0.611
57	6	986	0.316
58	20	1368	0.760
59	19	7709	0.128
60	25	762	1.707
61	6	3191	0.098
62	7	1635	0.223
63	11	1363	0.420
64	20	1178	0.883
65	20	4608	0.226
66	8	812	0.512
67	6	2628	0.119
68	9	7907	0.059
69	16	835	0.996
70	30	1926	0.810

Appendix E: Variables

α_i, α_j = AFSCs in pairing

$A_{i/j}$ = AFSC pair with α_i, α_j

τ_1 = Training time for first AFSC

τ_2 = Training time for second AFSC

γ_s = Average skills rating from survey

γ_t = Average training rating from survey

ϕ = Co-assignment coefficient

ω = Workload savings coefficient

λ_1 = Total personnel in first AFSC (x 1,000)

λ_2 = Total personnel in second AFSC (x 1,000)

η_1 = Personnel trained in first AFSC (per year)

η_2 = Personnel trained in second AFSC (per year)

ε = Potential manpower efficiencies for AFSC pair

μ = Additional man-years required for consolidated training

- $\mu_{\min}$ = minimum additional man-years required $\left(\max(\tau_1, \tau_2)\right)$
- μ_w = weighted additional man-years required
- $\mu_{\max}$ = maximum additional man-years required $\left(\tau_1 + \tau_2\right)$

$\rho = \varepsilon / \mu$ = Manpower-Training Ratio

Appendix F: Equations

$$\varepsilon = 1{,}000\phi\omega\left(\frac{(\gamma_s - 1)}{4}\right)\left(min(\lambda_1, \lambda_2)\right)$$

$$\mu_{\min} = \left(max(\tau_1, \tau_2)\right)\left(\eta_1 + \eta_2\right) - \tau_1\eta_1 - \tau_2\eta_2$$

$$\mu_w = \left(\left(\tau_1 + \tau_2\right) - \left(\frac{(\gamma_t - 1)}{4}\right)min(\tau_1, \tau_2)\right)\left(\eta_1 + \eta_2\right) - \tau_1\eta_1 - \tau_2\eta_2$$

$$\mu_{\max} = \left(\tau_1 + \tau_2\right)\left(\eta_1 + \eta_2\right) - \tau_1\eta_1 - \tau_2\eta_2$$

$$\rho_{\max} = \frac{\varepsilon}{\mu_{\min}}$$

$$\rho_w = \frac{\varepsilon}{\mu_w}$$

$$\rho_{\min} = \frac{\varepsilon}{\mu_{\max}}$$

Appendix G: Acronyms

AF/A1: Office of the Air Force Deputy Chief of Staff for Manpower and Personnel

AFPC: Air Force Personnel Center

AFSC: Air Force Specialty Code

MilPDS: Military Personnel Data System

SME: Subject Matter Expert

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Vita

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14. ABSTRACT

Throughout its history, the Air Force has experienced a growth in the diversity of the jobs it has been asked to perform, as well as a reduction in the number of personnel it has as a resource to fulfill these requirements. As a result, Air Force leadership has periodically had to review the set of required skills and consolidate similar specialties in order to complete its mission under these more restrictive manpower numbers. However, during previous consolidation efforts, Air Force Specialty Code pairs were identified anecdotally and subject matter experts were brought in to evaluate the feasibility of merging only these career fields.

In response to higher deployment tempos and a recent manpower drawdown, the Air Force Deputy Chief of Staff for Manpower and Personnel received a tasking to develop an objective, repeatable process for identifying AFSC pairs that may be consolidated to ease the operations tempo on Airmen within the force. This research is in response to that tasking and addresses the issues associated with merging specialty codes, ultimately formulating an objective cost/benefit ratio to identify skill pairings which will be likely to merge successfully.

15. SUBJECT TERMS
Air Force Specialty Code, AFSC, Consolidation, Merge, Personnel, Manpower, Skill Pair, Training

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